PATENT SPECIFICATION (11) 1 603 625

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(21) Application No. 14562/77 (22) Filed 6 Apr. 1977

(23) Complete Specification Filed 6 Apr. 1978

(44) Complete Specification Published 25 Nov. 1981

(51) INT. CL.[3] C04B 31/26

(52) Index at Acceptance
D2B 11A1 11A2 11AX 11AY 11E 36F1 36J1 37 38 39 41A 4A 5

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(19)

(54) FIBRE REINFORCED ARTICLES

(71) We, CAPE BOARDS & PANELS LIMITED, a British Company of Iver Lane, Uxbridge, UB8 2JQ, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to fibre-reinforced articles, and especially to fibre-reinforced gypsum plaster articles, for example plaster board, which have good strength and fire-resistance properties.

According to the present invention a shaped article is made from a mixture comprising gypsum plaster, mica and a cellulosic fibrous material. Further according to the invention a method of making a shaped article comprises forming into shape an aqueous slurry of gypsum plaster, mica and a cellulosic fibrous material, removing any excess water therefrom and allowing or causing the resultant material to set.

Gypsum plaster is calcium sulphate, both in the anhydrous and hydrated form, and a very suitable material for use in this invention is the hemi-hydrate. Both the α- and β-forms of the hemi-hydrated material may be used in accordance with this invention, as may mixtures of the α- and β-forms.

The mica used in accordance with the invention may, for example, be muscovite, biotite or phlogopite (e.g Suzorite-Trade Mark). Especially suitable grades of mica, which confer on the products of the invention excellent fire-resistance and low shrinkage properties, are those having an average particle size, or flake diameter, no greater than 2mm. Preferably the particle size of the mica is such that at least 95% is of a particle size less than 0.6mm. The mica preferably has a bulk density of less than 500Kg/m^3, most preferably less than 350Kg/m^3.

Suitable cellulosic fibrous materials for use in the invention include cellulose itself and its derivatives, newsprint, bleached and un-bleached paper pulp, sisal, cotton, wood chips, jute, hemp, straw, manilla, bagasse, abaca and ramie, inter alia.

The starting material for the production of shaped articles according to the invention may also contain fibrous mineral reinforcement, and suitable fibrous mineral reinforcement materials include glass wool, glass fibres, glass strands and glass filaments, for example of "E" glass (a low alkali borosilicate glass), and ceramic fibres. Preferred fibrous mineral reinforcement materials are mineral wool fibres such as rock wool and slag wool fibres. The rock wool fibres sold under the Trade Mark "Rocksil" are particularly preferred, since they have good dispersion characteristics, high temperature resistance, good tensile strength, and are relatively inexpensive. A further suitable reinforcement material is asbestos, the fibres of which, in its different forms, may, unless an asbestos-free product is required, be used in accordance with this invention. In those cases where fibrous mineral reinforcement is present it is suitably in an amount less by weight, than the amount of mica present.

Products of widely differing strength, density and fire-resistance properties, suitable for example as wall boards and ceiling panels, may be produced by varying the proportions of ingredients used in the mix. The solids content of the mix (i.e. disregarding the water used in the formation of the slurry) suitably comprises from 1 to 25%, preferably from 2.5 to 20%, by weight of cellulosic material, and from 1 to 25%, preferably 2.5 to 20% by weight of mica, the balance to 100% being gypsum plaster and any further desired additives as mentioned hereinbelow. When fibrous mineral reinforcement is also present the mineral fibres together with the mica preferably constitute up to 25% by weight, of the solids

content of the mix.

The shaped products of the invention may be formed by forming an aqueous slurry of the ingredients, forming this slurry into the desired shape, removing water as necessary, allowing the plaster to cure, and drying the product. Various water to solids ratios are suitable for the mix, depending upon the technique utilised in the production of the shaped final product. Generally speaking, the water:solids weight ratio will be in the range up to 20:1, the lower limit being determined by the minimum amount of water which is necessary for mixing and to set the plaster during curing of the shaped article. (As is known, different plasters have different water requirements). Water:solids ratios in the range 5:1 to 10:1 are particularly suitable for some forming techniques, and in others water:solids ratios from 0.4:1 to 1:1 are preferred.

After thorough mixing of the slurry, this is passed into a forming machine, which may be a mould or, when boards are to be formed, a continuous board forming machine such as a Magnani, Hatschek or Fourdrinier Machine. These latter machines are best suited for high water/solids ratios mixes; for lower water/solids ratios mixes it may be preferable to extrude the mix, or, for example, to charge a low water-content slurry from, for example, a paddle mixer directly under a moving belt upon which it is subsequently compacted by the action of one of a series of suitably positioned press rollers, into the desired shape. After compaction it is allowed to set to a dry state.

When using this latter forming technique it is preferable to use, in the formation of the slurry, the minimum amount of water which is required for mixing and to set the plaster, in order that no de-watering of the shaped slurry is necessary.

Where excess water is used in the formation of the slurry, i.e. when relatively high water/solids mixes are used, excess water is removed therefrom during or after shaping of the slurry, for example by suction, and the resulting material is then cured and dried to give the finished product.

In another method according to the invention, for the continuous production of a fibre-reinforced plaster board, a pre-formed slurry of plaster, mica and cellulosic material may be delivered onto a continuously moving conveyor, or onto a backing (e.g. paper) sheet placed thereon if desired, the inorganic fibrous reinforcement, e.g. glass fibre, when used being introduced, e.g. sprayed, in the dry state into this slurry a short distance downstream of the point of delivery of the slurry. Water is removed from the mixture, which is compressed against the conveyor as it starts to set. Partially set board can be removed from the conveyor, cut up as desired and stored while it is setting.

It should be noted that apart from the main ingredients recited above, the slurry, and therefore the final products, may contain other additives known in the art of making plaster products. These may include, for example;-

(a) accelerators, retarders, flocculants;
(b) waterproofing agents, e.g. resins in emulsion form;
(c) filter aids and fillers such as vermiculite, perlite and expanded clay.

The mixtures recited above are eminently suitable for the production of flat boards and panels with good strength and fire resistance, for example for use in the building and ship-building industries. They are also useful, however, for the production of other materials, such as ducting, corrugated sheets and cladding panels. Although boards and other shaped articles made from the composition of the invention may, if desired, be provided with facing and/or backing sheets, for example of paper, it is an important advantage of the composition of the invention that the presence of the cellulosic material in it renders the use of backing/facing sheets unnecessary.

In our Specification No. 46451/74 (Serial No. 1536663) we have described the production of boards from a composition comprising gypsum plaster, fibrous mineral reinforcement and a cellulosic fibrous material. The Examples in that Specification describe in detail the manufacture of boards using the press method, the Hatschek method and the Fourdrinier method. All of those methods, as described in Specification 46451/74 (Serial No. 1536663) may be used to manufacture boards from the compositions of the present invention.

The following Examples are given for the purpose of illustrating the invention.

Example 1

Boards were produced in the manner described in Example 1 of our Complete Specification 46451/74 (Serial No. 1536663) from the ingredients set out below and exhibited the properties which are also set out below. The mica was added to the fibre slurry before addition thereto of the plaster.

20kgs. fibre slurry (4.75 gms. newsprint and 12gms. "Rocksil" rock wool per 1000gms. water);
1600gms. retarded β-hemihydrate gypsum plaster;
160gms. muscovite mica (2mm.average diameter);

70 ppm. Magnafloc R156 added as a 0.025% aqueous solution;
water:solids ratio 11.0:1 (w/w).

This gave a dry board 457mm. x 457mm. x 9.5mm. with a density of 1020 Kg/m^3, and contained approximately 4.5% cellulose, 11.5% "Rocksil" and 7.65% mica, by weight. Typical Moduli of Rupture were 5.4 - 9.7 N/mm^2 in the density range 850 - 1150 Kg/m^3 (obtained by utilising different degrees of compression during formation of the boards).

Example 2

Using the procedure described in Example 1 of our Complete Specification No. 46451/74 (Serial No. 1536663) boards were made from the following materials and had the properties set out below.

13.5 Kgs. fibre slurry (12gms. newsprint per 1000gms water);
1300gms. unretarded α-hemihydrate gypsum plaster;
120ppm. Magnafloc R156 (added as before);
196gms. phlogopite mica (0.8mm. average diameter);
water:solids ratio 8.5:1 (w/w)

This gave a dry board 457mm. x 457mm. x 9.5mm. with a density of 875 Kg/m^3, and contained 9% cellulose and 11% mica, by weight. Typical Moduli of Rupture for boards made in this way, but using different degrees of compression, were 4.9 - 10.7 N/mm^2 in the density range 850 - 1150 Kg/m^3.

WHAT WE CLAIM IS:-

1. A shaped article made from a composition comprising gypsum plaster, mica and a cellulosic fibrous material.
2. An article as claimed in claim 1 wherein the cellulosic material is present in an amount of 1 to 25%, by weight, based on the solids content of the composition.
3. An article as claimed in claim 2 wherein the cellulosic material is present in an amount of 2.5 to 20%, on the same basis.
4. An article as claimed in claim 1, 2 or 3 wherein the mica is present in an amount of 1 to 25% by weight, based on the solids content of the composition.
5. An article as claimed in claim 4, wherein the mica is present in an amount of 2.5 to 20%, on the same basis.
6. An article as claimed in any of claims 1 to 5 wherein the mica has an average particle size not greater than 2mm.
7. An article as claimed in any of claims 1 to 6 wherein the mica is muscovite, biotite or phlogopite.
8. An article as claimed in any of claims 1 to 7 wherein the cellulosic material comprises one or more of cellulose, cellulose derivatives, newsprint, bleached and unbleached paper pulp, sisal, cotton, wood chips, jute, hemp, straw, manilla, bagasse, abaca and ramie.
9. An article as claimed in any of claims 1 to 8 containing also fibrous mineral reinforcement.
10. An article as claimed in claim 9 wherein the mica and fibrous mineral reinforcement together constitute up to 25% by weight of the solids content of the composition.
11. An article as claimed in claim 9 or 10 wherein the fibrous mineral reinforcement includes one or more of glass wool, glass fibres, glass strands, glass filaments, ceramic fibres, mineral wool fibres and asbestos fibres.
12. An article as claimed in claim 11 wherein the fibrous mineral reinforcement comprises rock wool or slag wool.
13. An article as claimed in any of claims 1 to 12, wherein the composition is in the form of an aqueous slurry.
14. An article as claimed in claim 13 wherein the water: solids weight ratio of the slurry is in the range up to 20:1.
15. An article as claimed in claim 14 wherein the water: solids ratio of the slurry is in the range 5:1 to 10:1.
16. An article as claimed in claim 14 wherein the water: solids ratio of the slurry is in the range 0.4:1 to 1:1.
17. An article as claimed in any of claims 1 to 16 wherein the composition also includes one or more of the following:– a setting accelerator or retarder, a flocculant, a water-proofing agent, a filter aid, a filler.
18. An article as claimed in any of claims 1 to 17 which is a board or a panel.
19. A method of making a shaped article which comprises forming into shape an aqueous slurry comprising gypsum plaster, mica and a cellulosic fibrous material, removing any excess water therefrom and causing or allowing the resultant material to set.
20. A method as claimed in claim 19 comprising (i) delivering onto a continuously moving conveyor, or onto a backing sheet placed thereon, an aqueous slurry of gypsum plaster, mica and cellulosic fibrous material, (ii) introducing into said slurry, at a position downstream of the point of delivery of the slurry onto the conveyor or backing sheet,

fibrous mineral reinforcement, (iii) removing water from the mixture, and (iv) compressing the slurry against the conveyor whilst the slurry is caused, or allowed at least partially to set, step (ii) being an optional step.

21. A method as claimed in claim 19, substantially as described in either of the Examples.

22. Reinforced gypsum plaster shaped articles whenever made by a method as claimed in any claims 19 to 21.

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Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1981.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.